1 AUTONOMOUS STORAGE FOR BACKUP, RESTORE, AND FILE ACCESS

2 FIELD OF THE INVENTION

3 The present invention relates to methods and apparatus
4 to provide secure autonomous storage for backup,
5 restore, and file access.

6 BACKGROUND OF THE INVENTION

7 There is a considerable amount of prior art in the of
8 field of backup and restore systems. Several well-known
9 backup and restore systems are currently marketed by
10 companies such as Veritas and IBM. These systems
11 provide reliable, secure backup and restore
12 capabilities by utilizing a server that contacts each
13 registered client in turn to request to a backup
14 session. The client system generally has an agent
15 installed that communicates with the backup server, and
16 together the backup server and client agent negotiate a
17 mutually acceptable arrangement for performing the
18 backup. The server might contact the client and tell
19 the client that it will be available in the next half
20 hour to perform a backup of the client, and ask if the
21 client can agree to that schedule. If so, the client
22 waits to be contacted by the server and makes
23 preparations for the backup if required.

24 These backup systems usually require a server and one
25 or more clients. The server oversees the operation and
26 provides the storage for the backed up files. In
27 general, the clients are polled to provide their backup
28 data to ensure that the server has the capacity to

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1   perform the backup at the specified time, with backup

2   performed at the convenience of the server, and not the

3   client(s). In order to complete the backup, however,

4   the client system must be connected to the network at

5   the same time the backup server is available or the

6   backup cannot be completed.

7   For traveling users, getting their system backed up can

8   be a chore. In order to get backed up, the client

9   system must be on the network until contacted by the

10   backup server. It is likely that a traveling user's

11   system will never be connected at the very moment that

12   the server gets around to backing it up.

13   <u>SUMMARY OF THE INVENTION</u>

14   It is therefore an aspect of the present invention to

15   provide for secure and automatic backup of client data

16   even if the client system is not always connected to

17   the network or the backup server.

18   It is another object of the invention to provide such

19   backup in a manner that is virtually transparent to the

20   user.

21   The present invention provides for the on-demand backup

22   of the client system programs and data by using a

23   storage device and storage management software which is

24   preferably located in the client system's docking

25   station. However, although this invention is described

26   herein as being located in a local docking station

27   device, the storage portion of the invention can be

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1   located anywhere in the network provided that it is
2   accessible from both the client system and the server.

3   The invention, is directed to a method, a system and a
4   computer program product (software) for implementing
5   the method and system. For example, in a system having
6   a client computer, and apparatus for connecting the
7   client computer to a network having a server for
8   backing up the client computer, the invention is
9   directed to a method for transferring data from the
10   client computer to the server, comprising connecting
11   the client computer to the network; backing up data on
12   the client computer to a storage device attached to the
13   network when the client computer is connected to the
14   network; and transferring the data from the storage
15   device to the server. The transferring of the data from
16   the storage device to the server occurs at a time
17   determined by the server. The connecting may comprise
18   connecting the client computer to a docking station
19   connected to the network. The storage device may be
20   associated with the docking station.

21   The method may further comprise connecting the client
22   computer to the network a plurality of times before the
23   server backs up the data on the client computer, and
24   creating a new data set on the storage device for
25   transfer to the server each time the client computer is
26   connected to the network. The data sets are transferred
27   to the server in the order in which the data sets were
28   created.

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1 The connecting may comprise establishing a data
2 transfer link between the client computer and the data
3 storage device. The data transfer link may comprise
4 one of a wireless link and an infrared link.

5 If the client computer is off when connected to the
6 network, the method further comprises powering up a
7 storage device in the client computer; and transferring
8 data stored on the storage device in the client
9 computer to the storage device attached to the network.
10 If power to the client computer is turned on during
11 transfer of data stored on the storage device in the
12 client computer to the storage device attached to the
13 network, the transfer of data is suspended while the
14 client computer boots up. If the client computer is
15 initially on when connected to the network, but the
16 client computer is turned off, the method further
17 comprises suspending transferring data stored on a
18 storage device in the client computer to the storage
19 device attached to the network, to permit normal backup
20 of files on the client computer. If the client computer
21 is disconnected from the network during a first backing
22 up of data on the client computer to a storage device
23 attached to the network, and the client computer is
24 again connected to the network, the client computer is
25 backed up to the storage device on the network a second
26 time, and data is sequentially transferred in the
27 following order: first data transferred to the storage
28 device before the client was disconnected from the

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1 network, and then data transferred to the storage
2 device during the second time.
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4 **BRIEF DESCRIPTION OF THE DRAWINGS**
5 These and other aspects, features, and advantages of
6 the present invention will become apparent upon further
7 consideration of the following detailed description of
8 the invention when read in conjunction with the drawing
9 figures, in which:

10 Fig. 1 is a block diagram of a system in accordance
11 with the present invention.

12 Fig. 2 is a flow chart of a data back up process when
13 the client is connected to network.

14 Fig. 3A and Fig. 3b are flow charts of the data backup
15 operation for multiple connections of the client to the
16 network.

17 Fig. 4 is a flow chart of backup to a server.

18 **DESCRIPTION OF THE INVENTION**
19 Variations described for the present invention can
20 be realized in any combination desirable for each
21 particular application. Thus particular limitations,
22 and/or embodiment enhancements described herein, which
23 may have particular advantages to the particular
24 application need not be used for all applications.
25 Also, it should be realized that not all limitations

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1   need be implemented in methods, systems and/or
2   apparatus including one or more concepts of the present
3   invention.

4   Referring to Fig. 1, in a computer network 100, many
5   computer users utilize the same computer (shown as
6   client system 102) at the office as they do when
7   traveling. This is made easier by devices called
8   docking stations 103. A docking station is a unit that
9   contains connectors, plugs, and jacks necessary to hook
10   the client system 102 up to the network 100 (and
11   optionally to a server 101), a separate monitor (not
12   shown), a mouse 106, a separate keyboard (not shown),
13   and other devices. These devices plug directly into
14   the docking station 103, and the client system 102
15   snaps into the docking station. The docking station 103
16   connects the client system 102 electrically to the
17   proper devices and connectors attached to the docking
18   station 103. The client system 102 usually connects to
19   the docking station through some type of recessed
20   connector that is exposed only when the client system
21   102 is plugged into the docking station. Those skilled
22   in the art can appreciate that there are many ways that
23   a client system can be connected to a docking station.
24   A recessed connector is cited herein as an example of
25   how some docking stations are constructed. Using a
26   release button or release mechanism on the docking
27   station 103, the client system 102 can be removed from
28   the network 100 and external devices by simply lifting
29   it from the docking station 103. Thus, the user is not

1   required to remove plugs and jacks from the client
2   system 102 to disconnect it from external devices or
3   the network 100.

4   Traveling users come and go from the office
5   environment. They may visit the office in the morning
6   or in the evening to replicate mail, calendar, and
7   other information. Often, once the requested data
8   transfer has been completed, they remove the client
9   system 102 from the docking station 103 and leave to
10 visit customers. In this scenario, however, the client
11 system 102 often never gets properly backed up. The
12 chance that the client system 102 is connected to the
13 network at the very time the backup server 101 needs to
14 do a backup is very slim. For this reason, it is
15 better to do backup "on demand" when the customer needs
16 it, at the convenience of the client, not at the
17 convenience of the server as is done in current backup
18 products.

19 In accordance with the invention, in the docking
20 station 103, a small interface board 106, having a
21 small processor 108, and a disk drive or other storage
22 device 104 are installed, although in practice, these
23 components may be installed anywhere on the network.
24 The storage device 104 also may be a flash memory, an
25 internal disk drive, an external disk drive, a storage
26 card, or any other device capable of storing digital
27 data. In one implementation of the present invention,
28 the storage may also exist on the network interface
29 adapter.

1   When the user places the client system 102 on the

2   docking station, the action of attaching or connecting

3   the client system 102 to the docking station 103,

4   causes the storage device 104 to wake up and do an

5   immediate backup of the client system 102. The storage

6   device 104 may be powered from an external source, but

7   may also be powered from the internal power supply

8   (typically a battery) of the client system 102.

9   While the invention has been described above with

10   respect to placing the client computer 102 in the

11   docking station 103 in order to transfer data, the

12   invention does not require an actual physical coupling,

13   and a docking station need not be used. Data may be

14   transferred by wireless connection (including a short

15   range link), infrared link, or any other means, form a

16   client computer to a back up storage device on a

17   network capable of storing data until it is backed up

18   by a server. Preferable, the connection between the

19   client computer and the backup device uses some type of

20   encryption or other security means to ensure that the

21   data remains confidential.

22   Referring also to Fig. 2, if the client system 102 is

23   off when the user places it on the docking station 103

24   (step 200 of Fig. 2), the processor device and

25   associated hardware of the present invention cause the

26   disk drive (not specifically shown) of the client

27   system 102 to power up 202, utilizing either the power

28   from the docking station 103 or from the battery of the

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1   client system 102. The interface board of the present

2   invention 106 then commences to facilitate a very fast

3   copy from the client system 102 to the storage unit 104

4   located in the docking station 103 (step 203 of Fig. 2)

5   or some other location in the network.

6   If the client system 102 is already powered on, the

7   interface board 106 commences to facilitate a very fast

8   copy 203 from the client system 102 to the storage unit

9   104 located in the docking station or in some other

10   location in the network.

11   In accordance with the invention, if the client system

12   102 was powered down, the disk drive of the client

13   system is turned off once again at 205.

14   If power to the client system 102 is shut off during a

15   backup operation, the software of the present invention

16   continues autonomous backup of the client files at 203

17   using the interface board 106 in the docking station

18   103.

19   The data from the client system 102 is backed up to the

20   storage device 104, and the user can continue to use

21   the system normally while the backup is running. The

22   docking station 103, which is almost always attached to

23   the network, can now respond to the backup server 101

24   at any time, day or night, and it does not matter

25   whether or not the client system 102 is powered on.

26   The backup server 101 instead communicates directly

27   with the processing interface board 106 and the storage

28   device 104 in the docking station 103, and can now be

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backed up at the normal server schedule. When communicating with the docking station 103, the backup server 101 operates as if it were communicating directly with the client system 102, and has no indication that it is instead communicating with the docking station 103.

It is important to note that two distinct backups take place using the present invention. The first backup is the backup that takes place between the client system 102 and the processor and storage of the present invention. The second backup takes place between the server and the docking station.

If the docking station contains no data (the client has never been backed up) a backup is first done from the client to the storage device and processor of the present invention, then the normal backup done between the server and the docking station. As far as the server is concerned, it is doing a normal backup to the client, when in reality, it is actually doing a backup of the storage of the present invention.

It is possible that in certain circumstances the connection of the client computer to the network may be interrupted during local backup of the client computer to the storage device associated with the docking station. While a fast copy routine will tend to minimize the likelihood of this happening, there are several measures that may be taken to deal with this possibility. In a first case, the user of the client

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1 computer may be prompted with a display indicating that
2 backup is taking place, and that the client computer is
3 to remain connected to the network through the docking
4 station or any other connection being used.   In a
5 second case, transfer to the local storage device is
6 suspended as soon as the connection is broken, but a
7 partial data set is saved on the local storage device.
8 Then, when the client computer is again connected to
9 the network, a full data set is saved. When the server
10 is connected for backup to the server, the partial data
11 set and then the full data set are sequentially backed
12 up to the server, in a manner similar to that described
13 above.   A specific approach is set forth below.

14 Fig. 3A and Fig. 3B deal with the situation in which
15 the client system 102 is placed in the docking station
16 103 (or connected to the docking station by a data
17 link), but is removed from the docking station 103 (or
18 the data link is severed) and then inserted again
19 before local backup has been completed.   Referring to
20 Fig. 3A, if the client computer is removed, a reject
21 request 301 is generated. If a local backup operation
22 is being conducted, a flag is set at 302, and the
23 client computer is ejected (removed) from the docking
24 system at 303.   If there is no backup running, the
25 removal or ejection takes place at 304, without setting
26 the flag.

27 Referring to Fig. 3B, when the client computer 102 is
28 again inserted into the docking station, or a data link
29 is reestablished at 306, the state of the flag is

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1 checked.   If the flag was not set, local backup is
2 performed at 307 to create a backup data set in the
3 storage device 104 associated with the docking station.
4 Normal operation continue 308.   If the flag was set, a
5 new backup data set is created at 309.   There are now
6 at least two backup data sets, depending on the number
7 of times that the client computer 102 is connected to
8 the docking station 103 before data is backed up to the
9 server 101.

10 Referring to Fig. 4, eventually, perhaps on some
11 predetermined schedule, such as during early morning
12 hours, when a great deal of network traffic is not
13 expected, the server is connected to the docking
14 station, and backup to the server starts at 400. At
15 401, a determination is made as to whether there are
16 any data set to back up. If there are none, the backup
17 operation to the server is terminated at 402. If there
18 are data set to back up, the oldest (the data set
19 generated first) is backed up to the server at 403. At
20 404, a determination is made as to whether there are
21 any additional data set to back up. If there are, then
22 operations return to 403 and the next data set is
23 backed up to the server. When all data set have been
24 backed up, as determined at 404, backup operations to
25 the server are terminated, at 405.

26 The present invention may also be used to facilitate
27 file sharing or distribution. If a file on a client is
28 placed on a server, it may be made available for
29 general distribution to other users of the server,

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1   after being backed up to the server as data. Thus,
2   files on the server, whatever their source can also be
3   downloaded to selected clients, or to all clients, as
4   an adjunct to the backup processes described above.

5   The present invention can be realized in hardware,
6   software, or a combination of hardware and software.
7   Any kind of computer system - or other apparatus
8   adapted for carrying out the methods and/or functions
9   described herein - is suitable. A typical combination
10 of hardware and software could be a general purpose
11 computer system with a computer program that, when
12 being loaded and executed, controls the computer system
13 such that it carries out the methods described herein.
14 The present invention can also be embedded in a
15 computer program product, which comprises all the
16 features enabling the implementation of the methods
17 described herein, and which - when loaded in a computer
18 system - is able to carry out these methods.

19 Computer program means or computer program in the
20 present context include any expression, in any
21 language, code or notation, of a set of instructions
22 intended to cause a system having an information
23 processing capability to perform a particular function
24 either directly or after conversion to another
25 language, code or notation, and/or reproduction in a
26 different material form.

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1 Thus the invention includes an article of manufacture
2 which comprises a computer usable medium having
3 computer readable program code means embodied therein
4 for causing a function described above. The computer
5 readable program code means in the article of
6 manufacture comprises computer readable program code
7 means for causing a computer to effect the steps of a
8 method of this invention. Similarly, the present
9 invention may be implemented as a computer program
10 product comprising a computer usable medium having
11 computer readable program code means embodied therein
12 for causing a function described above. The computer
13 readable program code means in the computer program
14 product comprising computer readable program code means
15 for causing a computer to effect one or more functions
16 of this invention. Furthermore, the present invention
17 may be implemented as a program storage device readable
18 by machine, tangibly embodying a program of
19 instructions executable by the machine to perform
20 method steps for causing one or more functions of this
21 invention.

22 It is noted that the foregoing has outlined some of the
23 more pertinent objects and embodiments of the present
24 invention. The concepts of this invention may be used
25 for many applications. Thus, although the description
26 is made for particular arrangements and methods, the
27 intent and concept of the invention is suitable and
28 applicable to other arrangements and applications. It
29 will be clear to those skilled in the art that other

1   modifications to the disclosed embodiments can be

2   effected without departing from the spirit and scope of

3   the invention. The described embodiments ought to be

4   construed to be merely illustrative of some of the more

5   prominent features and applications of the invention.

6   Other beneficial results can be realized by applying

7   the disclosed invention in a different manner or

8   modifying the invention in ways known to those familiar

9   with the art. Thus, it should be understood that the

10   embodiments has been provided as an example and not as

11   a limitation. The scope of the invention is defined by

12   the appended claims.